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NOTES ON THE HABITS OF INJURIOUS GRASSHOPPERS IN MANITOBA.

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Any evidence which would help us to forecast grasshopper outbreaks, or to anticipate and check them before they become acute, is worth considering and on this account the recently annunciated "phase" theory, and the still later "reservation" theory, should secure the careful consideration of American entomologists.

The "phase" theory, originated by Uvarov, has recently received much attention and there seems no longer any reason to doubt its application to a number of Old World species as well as to at least one species from North America. Indeed there is now strong reason for suspecting that the theory can be applied to a number of others and perhaps to all those species which congregate in sufficient numbers to become of marked economic importance.

During our field studies of the past two years it has not required any great discernment to note that the individuals in the concentrated gatherings of *Camnula pellucida* Scud., the clear-winged grasshopper, are much yellower in colour than the normal solitary forms of the same species. They also appear to be somewhat more slender on an average, but we have not observed any marked lengthening of the wings.

With *Melanoplus bivittatus* Say., the two-striped grasshopper, the paler colours in the migratory phase are not so noticeable but what is more striking is the very appreciably greater percentage with longer wings. Under non-swarming conditions there are always some individuals with long wings and these cannot be separated from the migratory forms. In this solitary phase, however, only a small percentage of the insects have long wings whereas in the swarming phase the wings are uniformly longer. Furthermore, we can again discern, in the swarming phase, a distinctly more slender body which is associated with an agility unlike that of the rather clumsy solitary form. Thus in 1932 *bivittatus*, for the first time in our experience, assumed all the aspects of a migratory locust and it flew long distances and in such numbers that the larger lakes were polluted with the drowned insects. Indeed the shores of Lake Winnipeg presented a mass of decaying grasshoppers several inches deep, creating a condition far from pleasant to the nearby holiday seekers.

There also seemed to be a tendency, in Saskatchewan, where *Melanoplus packardi* Scud., Packard's grasshopper, was abundant, for that insect to show a lighter colour and a trifle longer wing length than usual but closer observation will be necessary to verify this.

In none of the above mentioned species was the swarming phase well defined and in reality the transformation from the solitary to the migratory phase seemed to stop at a transition stage.

Whether crowding is the only factor necessary to produce the lighter colours and long-winged phase in grasshoppers remains to be proven. It is certainly strange, if this is the case, that *Melanoplus mexicanus* Saus., the lesser migratory grasshopper, has never assumed the migratory phase in eastern North American and that this phase has always been more prevalent westward towards the Rocky Mountains. Moreover, it is known that lighter colours can be produced artificially by subjecting the nymphs to abnormally high temperatures. For a number of years we have attempted to produce the long winged phase *spretus* from its solitary phase *mexicanus* by crowding but without success. On the other hand, I have obtained much longer wings in *Melanoplus borealis extremus* Dodge and in *M. fasciatus* DeG. by rearing them in confined quarters under hotter and more sunny conditions than they normally inhabit. Attempts to produce long wings in *Hypochlora alba* Dodg., an inhabitant of semi-arid areas, under crowded conditions entirely failed.

In Uvarov's "Locusts and Grasshoppers" his plate IX shows, in colours, hoppers of the desert locust in both swarming and solitary phases and it is interesting to observe that the two phases are apparently different from the time of hatching. This might lead us to suspect that, in some instances at least, there was an inheritance through the egg. In other words, that it takes more than one generation of crowding to produce the migratory phase, although this (See Faure, 1932) is not always the case. Even three generations, however, did not provide the desired results with *M. mexicanus* Saus., in our cages.

Perhaps our grasshoppers are less susceptible to change than are those of other countries and on that account a longer time is required to bring out the abnormal characters present in the extreme migratory form. Or perhaps there is some condition of the atmosphere which is less rarely present in North America and more so in those countries where the change from one phase to another seems so easily brought about. In any case, further studies will remain necessary until someone definitely produces the long-winged *spretus* from the normal winged *mexicanus*.

The rapid rise of grasshoppers from normal to epidemic numbers apparently is brought about by various factors such as favourable weather, and an absence of natural enemies while the reduction may be due to unfavorable weather or entirely to diseases, parasites, and predators. During 1931, the last three were little in evidence but in 1932 all were conspicuous. In a number of instances local congregations of grasshoppers were almost wiped out by *Sarcophaga kellyi* Auld., while the combined efforts of *Systoechus vulgaris* Loew., several species of blister beetles larvae and carabid larvae accounted for approximately twenty per cent of the eggs over the entire province, indeed, in some areas the egg destruction reached fully 90 per cent.

During the present outbreak it has been observed that the larger egg-masses, such as are deposited by *M. bivittatus* Say, suffer much more from enemies than do those of *Camnula pellucida* Scud. or *M. mexicanus* Saus. It was also noted that the eggs of *mexicanus,* being usually in sandy land, suffered far more from carabid larvae than either of the other two. This, however, was not so when all were present in the same vicinity; under such circumstances *M. bivittatus* Say. again suffered most. It is possibly this concentration of natural enemies upon the eggs of *M. bivittatus* Say. which normally prevents the

species from rising to dangerous numbers. Otherwise the greater quantity of eggs deposited would favour its increase above all other associated species.

There is no doubt that weather is of much importance in grasshopper survival, both directly and indirectly. It is unnecessary here to go into details as to its wider influences but a few recent observations relating to meteorological influences seem worthy of record.

In 1931, Dr. J. R. Parker, of the United States Bureau of Entomology, was asked as to what he attributed the decrease in grasshoppers in some of the more arid sections of Montana. He replied that he suspected the exceptional dryness had burnt up the vegetation to such an extent that the newly hached hoppers were unable to survive. Interestingly enough we had reached the same conclusions, based upon a number of cage studies. In this connection it was noted during 1932, that in certain sections of Manitoba where it was exceptionally dry and hot, the adult grasshoppers not only ceased mating and egg-laying but in the case of *Melanoplus bivittatus* Say. a large number died almost surely due to a lack of moisture. It would seem, therefore, that there can be a marked reduction in the number of eggs laid by a general population due to excessive aridity. We also observed that a large number of egg-beds of *Camnula* were abandoned because of a lack of succulent vegetation, even after the insects had begun to oviposit on them. These field observations have been confirmed in our cage work and in every case the absence of succulent food, or moisture, has resulted in a marked reduction in breeding activities and at times in death.

Apparently *bivittatus* requires more moisture than either *M. mexicanus* Saus. or *Camnula*. We noticed in particular that the attraction to sow thistle (*Sonchus arvensis* L.) by this species seemed to be more marked during dry weather and because of the large amount of moisture which the plant contained. Thus it was observed that individual plants would be attacked by a number of the grasshoppers while others close by were untouched. The conclusion reached was that plants once bitten exuded a quantity of milky juice which was eagerly sought by the grasshoppers, and they were then devoured until little remained. Another plant would then be attacked in the same way until finally entire fields of the weed were stripped. A similar method of attack was noted on other succulent weeds although they rarely suffered to the same extent as sow thistle.

The reservation theory elucidated by Uvarov (1932) is one which needs careful study in North America. We have not been able to fit the evidence obtained from observing our local grasshoppers, into such a theory but it does not follow that more exact observation may not provide a different conclusion, or that it may not be applicable to the grasshoppers in other parts of the continent. The habits of *Camnula pellucida* Scud. are best adapted to an application of the theory because of the well-known practice of the insect in concentrating for egg-laying. Moreover, it shows a very strong preference for a comparatively few grasses and in Manitoba a majority of its eggs are to be found among the roots either of *Agropyron smithii* Ryde. or *Poa pratensis* L. Even the dark coloured, or solitary phase, shows this preference. Both these grasses, however, are widespread, furthermore when they are not present the barley grass, *Hordeum jubatum* L., or brome grass, *Bromus inermis* Leyss., provide suitable substitutes.

There is no doubt that all our outbreaks of grasshoppers have their inception in local areas. On the other hand, there is always a marked increase

of the insects over all suitable places. Thus while certain favoured sections produce outbreaks first, others may do so the following year until finally the spread of the original concentrations, the formation of new ones and the more steady rise elsewhere, leads to a general epidemic.

Another feature connected with *Camnula* is the tendency to shift its breeding grounds. Many examples of this could be cited but two must suffice. In 1932, there was a very general movement eastward or northeastward which resulted in a much greater concentration of eggs in the eastern part of the province and a marked reduction in those areas where the insects were most numerous early in the season. In the second instance there was a particularly heavy concentration of eggs in a dry lake bottom near Whitewater in 1931, but in the following year the adults forsook this area and concentrated on the roadsides north and east of it. Since there was little difference in the conditions from the previous year, the change of egg-beds seems merely to have been part of a normal habit to change quarters. Perhaps it should be added that the habit is by no means a constant one.

Another point is that outbreaks of *Camnula* do not always begin in the same part of the province. In 1919, they originated in the southwest; in 1931, some 200 miles more to the east.

In the case of *Melanoplus bivittatus* Say. the reservation theory fits even less satisfactorily because in this case there is an extremely wide range of food plants and a broad selection of egg sites. Such concentration as undoubtedly occurs may take place almost anywhere. Furthermore, it must be recalled that the present severe outbreak of this species is the first of which there is any record in Manitoba. Obviously under such circumstances there can be no permanent reservation or central concentration.

One cannot help thinking that a similar line of reasoning applies in the case of *M. mexicanus* Saus. In 1900, the outbreak of this species was concentrated in south-central Manitoba; in 1912 it again appeared in the same areas; while in 1919-23 *Camnula* dominated and there were only local outbreaks of *mexicanus* chiefly to the west. Finally in 1931-32 we find the concentrations confined to the extreme southwest and to a few small areas elsewhere including Sifton far to the north. All these outbreaks have been of the supposedly solitary phase although present in large numbers. In 1900-3, however, there was a small percentage of the long-winged phase *spretus* present,—the last to be noted in Manitoba.

After reviewing all the available evidence we are inclined to believe that while the reserve theory cannot be satisfactorily applied to the local species it should, nevertheless, be borne in mind that all our grasshoppers have both food and site preferences, *Camnula* preferring as food *Agropyron smithii* Ryde. or *Poa pratensis* L. and inhabiting roadsides or pasture fields, *Melanoplus bivittatus* Say. tending to frequent the areas of tall weeds and rank, but not dense vegetation; while *Melanoplus mexicanus* Saus. inhabits the sandy areas of somewhat sparse growth. Whether it will ever be practical to watch these areas and check the increase before it becomes too great is a matter yet to be proven. Nevertheless, the theory of reservations is well worth careful study wherever grasshoppers become troublesome.

To those not familiar with North American grasshoppers it may be stated that in all the injurious Acrididae there is a prolonged diapause in the egg stage lasting over the winter. Also rather close observation has convinced us that there is a period of at least ten days before the newly developed adults become sexually mature. It is doubtless during this time that migratory movements are most indulged in but this is not necessarily the case, because movements, in which the insects fly many miles, may continue for a month or more. The high, sustained flights, however, are most frequent in species of the genus *Melanoplus*. *Camnula* is more apt to fly at low elevations and to speedily assemble on favourite breeding areas where the grass is quickly eaten down and mating and egg-laying soon undertaken. These denuded egg-beds are easily recognized. They are gradually enlarged by the feeding insects. Should succulent food be unavailable the insects leave the situation and select another, in a more favourable locality. As a rule, the eggs are quickly laid and within a month the grasshoppers depositing them may have all died. The habits of species of the genus *Melanoplus* are quite different. The flight, as has already been pointed out, may continue much longer, there is also a longer period between the time of reaching adult development and sexual maturity and it may be several weeks before egg-laying begins. It is doubtless the prolonged preoviposition period which permits a more extended time for migration.

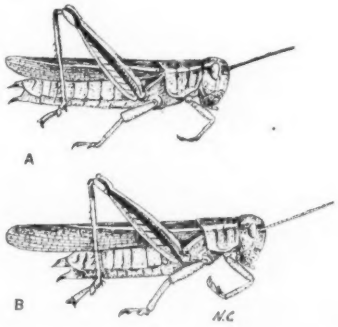

Fig. 1. *Melanoplus bivittatus* Say. *A*, Solitary phase; *B*, Migratory phase.

We feel we can defintely conclude that prolonged flights in many North American Acrididae are a regular part of the insects' normal habits. This has been proven by yearly observations carried on over more than 30 years. In times of outbreaks, however, such migration became vastly more intense and a greater proportion of individuals appear to develop the wings necessary for sustained flight.

Prolonged mass migration in nymphs is a not unusual character in both *Camnula* and *Melanoplus mexicanus* Saus. In 1932, for example, fourth and fifth instar *Camnula nymphs* migrated in great numbers from a large breeding ground some two miles away, and passing over an intervening grain field swarmed onto wheat crops. Millions, however, marched along a railway instead of seeking food from the adjacent grasses. This migration took place during the heat of the day after the early feeding was over. It was evidently not a search for food.

The rise and fall in grasshopper abundance in Manitoba, as we have pointed out elsewhere (1932), appears to occur in rather definite cycles. Such cycles include not only those species which normally damage crop but many others of little economic importance. From the available evidence it is believed that such cycles can be foretold with reasonable accuracy many years ahead. Moreover these cycles coincide with the periodicity of grouse and probably a number of other natural phenomena.

It is difficult to compare the grasshopper outbreaks in Manitoba with those in the Old World because it is obvious that the conditions are entirely different. Mass concentrations with us are rare, at least, if they do occur, they appear to form part of a general density of the grasshopper population and may take place over large areas of the country. Thus in the egg-survey made in the autumn of 1932 we found areas covering hundreds of miles in which a series of concentrations occurred separated by perhaps not more than their own length of semi-free spaces. In these semi-continuous infestations eggs of *Camnula* and *Melanoplus bivittatus* Say. were present in numbers varying from a thousand to as high as over 100,000 per square foot. As a rule those egg-beds were on sodded roadways some 99 feet wide but adjacent pasture fields might be equally thickly studded with eggs. It will be noted that under these conditions an individual swarm can scarcely be recognized and that the adults maturing from these eggs might well form one continuous swarm. This they frequently do but it is rarely that they appear to form the close concentrations resembling those met with in Europe, Asia, Africa or South America. It is possible, however, that the Rocky Mountain locust of old did so. Also there may be a misunderstanding among some of us as to what constitutes a swarm. To make matters clear, on that point, it might be added that even last summer grasshoppers were flying in such numbers that they formed a perceptible haze over the sun. These, however, were not concentrations but merely part of a general migration covering wide stretches of the country and continuing for several hours. Some of the insects were flying within a few hundred feet of the ground, others so high that they could only be seen through field glasses.

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NEW SPECIES OF CARPHOBORUS EICH. WITH KEY TO SPECIES NORTH OF MEXICO (COLEOPTERA-SCOLYTIDAE)

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While making an intensive study of the bark beetles of Western North America, I noticed that two of the species in the genus *Carphoborus* were new. Since the last key to the species of this genus has been compiled (Swaine, 1918) Dr. Swaine has described five new species which with my two would more than double the number in the genus. I therefore feel that a new key should be made.

I am indebted to the Museum of the California Academy of Sciences for the use of its collection of this genus, and to Dr. E. C. Van Dyke of the University of California for his helpful criticisms.

KEY TO THE SPECIES OF THE GENUS CARPHORBORUS EICHOFF.

1. The declivital interspaces moderately or feebly, subequally elevated; the front concave at least in the male 2
   The declivital interspaces alternately unequally prominent 5
2. Sutures of the antennal club at least slightly arcuate; declivital interspaces 1 and 3 very feebly serrate in at least one of the sexes 3
   Sutures of the antennal club nearly straight; declivital interspaces 1 and 3 distinctly serrate 4
3. Sutures of the antennal club transversely arcuate; without an epistomal process extending anteriorly, on *Pinus ponderosa* and *P. lambertiana*. Calif. ..... *simplex* Lec.
   Sutures of the antennal club obliquely arcuate; an epistomal process extending anteriorly between the mandibles, on *Pseudotsugae taxifolia*. Calif. ..... *vandykei* n. sp.
4. The elytral declivity moderately and subacutely serrate on alternate interspaces; the elytra reddish, the interspaces roughened, convex, indistinctly clothed with very small yellowish scales not concealing the surface; the front of the female with a blunt median tubercle surmounting the convexity, on *Pinus radiata*. Calif. ..... *radiata* Sw.
   The elytral declivity acutely, rather feebly serrate; the elytra black, reddish on the declivity, the interspaces feebly granulate and feebly convex, densely clothed with greyish scales almost concealing the surface; female with front unarmed, on white spruce. Alta., Man., Eastern slopes of the Rockies across northern Alberta, Saskatchewan, into Manitoba ..... *carri* Sw.
5. The elytra lightly punctate-striate, the strial punctures minute. Middle and Southern states ..... *bicristatus* Chap.
   The elytra strongly punctate-striate, the strial punctures coarse 6
6. Second declivital interspace normally wide. on pines. Calif. ..... *blaisdelli* Sw.
   Second declivital interspace reduced 7
7. Second declivital interspace obsolete 8
   Second declivital interspace narrow 10
8. Third and first declivital interspaces subequally elevated 9
   Third declivital interspace more strongly elevated than the first; antennal club only slightly longer than wide. N. Y., Tenn., Washington, D. C. ..... *bifurcus* Eich.
9. Third and first declivital interspaces very faintly elevated, on *Pinus*

sabiniana and *Pinus jeffreyi*. Calif.....*swainei* n. sp.
Third and first declivital interspaces moderately elevated, on white spruce. Alta. .....*sansoni* Sw.

10. Second declivital interspace very narrow.....11
Second declivital interspace moderately narrow, on *Picea canadensis*. N. W. Territories .....*andersoni* Sw.

11. Third declivital interspace very strongly elevated, on red spruce. N. B.... ..... *dunni* Sw.
Third declivital interspace moderately elevated; antennal club twice as long as wide, on *Pinus ponderosa*. B. C., Ut.....*ponderosa* Sw.

Carphoborus vandykei n. sp.

Length: 1½ to 2½ mm. Head with the front deeply concave, closely, transversely rugose, moderately, deeply, densely punctured and sparsely clothed with scale-like hairs; a single bifid carina-like tubercle medially between the eyes with the points bent anteriorly, simulating a V-shaped carina; median area of the epistoma extends anteriorly between the mandibles, as wide at the base as at the truncate tip, varying in length from moderately long to quite long, the surface is opaque with minute transverse rugosities, at the base there are two deep moderately large punctures, basal margin of the front moderately clothed with long hairs; the concavity is as wide as long, very sparsely punctate with small deep punctures, remainder is minutely, finely, shallowly granulate and very sparsely clothed with small scale-like hairs; sutures of the antennal club are obliquely arcuate, the tip of the club is strongly obliquely arcuate. Pronotum slightly constricted anteriorly, sides arcuate with a shallow transverse impression extending to the disc, densely deeply punctured on the posterior two-thirds and moderately densely punctured on the anterior third, punctures small, moderately clothed with short, scale-like hairs, wider than long 4.0:3.5. Elytra striae deeply impressed with large, deep, closely placed punctures; interspaces slightly wider than the striae, become wider on the declivity except the second which gradually disappears, transversely rugose, finely punctured, and clothed with short scale-like hairs; declivity with a very few, almost obsolete, granule-like separations on the first interspace, third with not many more but slightly larger, fifth and seventh meeting at the declivity, each having a very few serrations, the ninth with several widely spaced serrations and meeting the third near the base of the declivity, the first, third and ninth interspaces are slightly convex, the second and eighth almost obsolete, none of the tubercles of the declivity longer than the scale-like hairs. The venter of the abdomen is very sparsely clothed with stiff bristle-like hairs.

The female has the front with the concavity larger, extending between the eyes, without the tubercle between the eyes; the concavity is sparsely fringed with long hairs, surface glabrous, moderately punctate with deep moderate punctures, except at a small median portion which is smooth and very slightly elevated and very minutely, finely, shallowly granulate. The serrations of the declivity are more distinct and more numerous than in the male.

This species is separated from *C. simplex* Lec. by its obliquely arcuate antennal sutures, oblique truncate tip of the club and by the epistomal process. It is easily distinguished from *C. radiata* Sw. by the antennal club being less than twice as long as wide, the sutures of the club being oblique and strongly

arcuate, the serrations of the elytral declivity less pronounced, and the front of the female unarmed. *C. carri* Sw. differs from this species by being more densely clothed with scale-like hairs and smaller in size.

Holotype and allotype are retained in the author's collection, one pair of paratypes will be placed in the collection of Dr. Van Dyke, deposited in the California Academy of Sciences, San Francisco, one pair will be sent to Dr. Swaine for the Canadian National Collection, one pair in the collection of Mr. Wohletz and the remainder in my own collection.

Long series of this species were collected by Dr. E. C. Van Dyke, Mr. E. F. Wohletz, and myself from beneath the bark of small dead branches of Douglas fir, *Pseudotsugae taxifola* Lamb, on Mt. St. Helena, Calif., March 29, 1931.

Carphoborus swainei n. sp.

Length : 2-3 mm. Head with the front deeply concave, closely transversely rugose and densely, closely, deeply punctate, very sparsely clothed with short scale-like hairs, anterior margin clothed with moderately long bristle-like hairs; median area of the epistoma extends anteriorly between the mandibles, slightly broader at the base than at the truncate tip, the surface is very finely rugose and opaque; the median tubercle between the eyes appears like two large granules latitudinally side by side on an elevation; the convexity is wider than long, shining, very sparsely punctate with moderately deep, moderate sized punctures, the remainder is minutely, finely, shallowly granulate, and sparsely clothed with small, scale-like hairs; the sutures of the antennal club are somewhat oblique, first suture straight, second slightly arcuate, the apex of the club is scarcely obliquely rounded. Pronotum with the sides slightly arcuate, very slightly sinuate anteriorly, very closely, deeply, moderately punctured on the posterior two-thirds and very faintly, sparsely punctured, densely finely granulate on the anterior third, moderately clothed with short scale-like hairs, wider than long, 3.75:2.5. Basal margin of the elytra with the serrations widely spaced; striae deeply impressed with moderately large punctures closely placed; interspaces uniformly wider than the striae, transversely rugose, clothed with short scale-like hairs; declivity with the first, third, fifth, seventh and ninth interspaces very faintly serrate with granular-like serrations, first moderately elevated, third and ninth distinctly elevated, second obsolete, eighth nearly so, the fifth and seventh and the third and ninth meeting on the declivity. Venter of the abdomen sparsely clothed with stiff moderately long, bristle-like hairs and very sparsely interspaced with short scale-like hairs on all but the first segment.

The female has the front with the concavity extending between the eyes, densely fringed with long hairs, the surface shining and definitely, very minutely, finely, shallowly, reticulate, with only a very few moderate punctures near the edges; without the median tubercle between the eyes as in the male, but with a minute latitudinal carina-like tubercle at the base of the epistomal process; declivital asperities slightly larger than in the male.

This species is separated from *C. blaisdelli* Sw. by its antennal club being longer than wide, the basal suture of the club almost straight, elytral striae only moderately rugose, and the second declivital interspace obsolete. It is readily distinguished from *C. ponderosa* Sw. in that it is a more slender species, its antennal club being less than twice as long as wide, the sutures of the club oblique,

elytral striae only slightly convex, third and first declivital interspaces subequally elevated. It is distinct from *C. bifurcus* Eich., *C. andersoni* Sw., and *C. sansoni* Sw. by the third declivital interspace being decidedly less elevated.

The holotype and allotype will be retained in the author's collection with a number of designated paratypes collected on Mt. Diablo, Calif., February 22, 1931. A long series of this species was collected by the writer from under the bark of small dead branches of Digger pine, *Pinus sabiniana* Doug. Several specimens were taken in the Arroyo Valle, Alameda Co., Calif., by Mr. Wohletz and myself, and a series was also collected by Dr. K. A. Salman on *Pinus jeffreyi* Vasey at Laguna Recreational Area, Cleveland National Forest, Calif., on March 8, 1931. A pair of paratypes will be sent to Dr. Swaine for the Canadian National Collection, one pair will be placed in the collection of Dr. Van Dyke, deposited in the California Academy of Sciences.

NOTES ON PSEUDOLUCANUS PLACIDUS (SAY). (LUCANIDAE, COLEOPTERA).

BY LORUS J. MILNE.

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The literature concerning the large Stag-beetle *Pseudolucanus placidus* (Say) contains many conflicting and misleading data. Since the species occurs in exceptional abundance in a very restricted sandy area surrounding the author's home, it became a fairly easy task to check up on these statements. The present paper contains the information gathered during the past several years.

In 1932, the emergence of beetles on an observation plot of some two square yards began on June 3 with a few specimens, rose to the maximum intensity on the 5th and slowed off again in a die-away curve to the 18th of the same month. During this time approximately two hundred specimens were taken from the area, all between 8:45 and 10:00 p. m. (Eastern Daylight Saving Time), i.e., between dusk and dark. No specimens were found above ground before the earlier time, and all apparent emergence was over by the later hour. Several specimens were caught as they flew *to* the plot; none were allowed to escape from it. The numerical data quoted below are taken from the specimens coming from the experimental area except where otherwise indicated.

In other years, the emergence and flight occurred on very similar dates, although specimens taken as early as May 25th and as late as June 30th are at hand. The beetles come through the sod, boring away from their pupal chambers a cylindrical tunnel of non-uniform course, in diameter an easy fit for their bodies. The explanate tibial apices are used to pack the earth away behind as fast as it is dug from in front. The last portion of this exit-way is burrowed open to the surface during the afternoon preceding emergence, a slight amount of sand pushed away from the mouth of the hole, and during the early evening the occupant may be induced to bite at a match or the finger tip, and to hold on long enough to be drawn forth. It seems that all are facing out, and clinging to the sides of the hole, between one and a fraction, and two inches below the surface of the ground.

P. placidus, as indicated above, has a rather surly disposition despite its name, but the insect is excessively stupid, and its temper consequently of little import. Evidence of its lack of intelligence is the rarity with which a specimen,

having fallen upon its back, is able to turn over again. The wings are seldom lifted, unless the insect has just been in aerial flight. The legs are idly waved about, to no avail.

On molestation, the fore-legs are straightened so as to raise the anterior end of the body from the ground, until the long axis of the beetle is at approximately sixty degrees from horizontal. In exceptionally vigorous specimens, the hind legs are used to kick the rigidly-ferocious body forward, the mandibles quivering with anticipation of use, but in most individuals, these limbs are merely spread widely and held stiffly, the jaws widely open but motionless. A mild pinch, stronger but less prolonged in females, may be given to a finger pushed between the mandibles. On more tender skin, as of the back of the hand, the marks of the teeth often remain for over a week, frequently attended by indications resembling mild infection. As the skin is never punctured, the condition is doubtless a simple but minute oedematous one. However, to the horror of small girls, and the delight of equally-young boys, the insect is a very conspicuous crawler on local lawns, and gives power and prestige to the child who dares handle it. The trivial name "June Bug" is applied to the species, in contradistinction to "May Beetle," which is used for members of *Phyllophaga* Harris, *(Scarabaeidae)*. The term "Pinching Bug" is purely descriptive, and the appelation given by some, *viz.* "Electric-light Bug" is frowned upon as a homonym of that given to *Lethocerus* Mayr, *Benacus* Stal, and *Belostoma* Latr., *(Heteroptera)*. There seems to be no reason for the name, either, since the beetles do not fly toward light, but are noticed there rather than elsewhere because of their hour of emergence.

This late emergence is doubtless of great survival value to the species, since only bats, owls, nighthawks and snakes would be their principal vertebrate enemies. During the day, domestic fowl, crows, hawks, and many insectivors would find them easy food. The disappearance of specimens from all observed localities is puzzling, however. A very few fly through any lighted area, yet after 10.30 p. m. all have vanished, and no trace of them can be found in the morning, other than empty exit-holes, and the occasional specimen on its back on the sidewalk, covered with devouring ants, a victim of its stupidity. Nor do excavations of invested areas yield specimens which have plainly dug themselves in again, although the usual number of imagines working their way to the surface (facing out) will be disclosed.

Beachdrift is given as a habitat for *P. placidus* at Ann Arbor, Mich., by Doctor M. H. Hatch, but whether this was an hiding place is uncertain. No rubbish pile around Toronto has been found to harbour adults, and the number washed up on the lake-shore or found cleaned out by ants, is pitifully small. It is possible that they are caught by fish, but no record of such hard parts as would inevitably remain in the stomach contents is known to those individuals investigating such matters for bass, trout, pickerel and perch under Professor W. J. K. Harkness, of the Ontario Fisheries Research Board. It is his belief that these fish are the only surface feeders likely to eat such food as large hard beetles which had fallen in the water.

Mating is terrestrial, at about 9.15 p. m., the pairs often badly matched for size. There appears to be no elaborate courtship, such as is described for the European *Lucanus cervus* Linn., and on no occasion has any use of the

mandibles in contest been noted, although much watched for. Such knightly encounters, with the female standingly meekly by, seemingly are restricted to the insects of the Old World, where tradition, chivalry and family honour are so highly esteemed. The females, however, must be in great demand, since at least 65% of all specimens taken on any evening were males, and as high as 85% was most common. Blatchley's remark (1910) that females were rare, may thus be broadened to include *P. placidus* as well as *P. (Lucanus) dama* (Fab.)* It should be observed that in the case of 1932, the percentage of female *P. placidus* was 26% greater on June 6th than on the preceding night, when the huge emergence had taken place from the experimental plot. The explanation is not clear, since all these beetles had been waiting since very late autumn, in the perfect state, ready for their one (?) night's activity, having pupated in early fall.

Numerous attempts to obtain eggs have been made, with no success. The principal method adopted was to convey undisturbed, mated pairs of beetles to a large wooden box, covered with netting and half-filled with moist sand of such fineness as to pass easily when dry, through the 14-mesh screen bottom. The specimens crawled about and died within four days in every case. Imagines do not feed, so that the span of adult life is necessarily short. This fact is quite important to the local gardener and flower-grower, as hordes of such large insects would easily ruin his plants, were they half as hearty eaters as the Rose Chafers (*Macrodactylus subspinosus* (Fab.)), which worry him a few weeks later. Professor A. F. Coventry of the Department of Biology, University of Toronto, has several times told the author of an old vine-covered stump in a friend's lawn near London, England, infested with *Lucanus cervus* Linn., where specimens could be collected *at any time during the summer.* Mr. Charles E. Corfe of this city, but originally of Winchester, bears out this statement from his own observations on the species. Feeding seems a necessary accompaniment of such active longevity, and it may thus be that the type genus of *Lucanidae* differs from *Pseudolucanus* Hope in this additional particular.

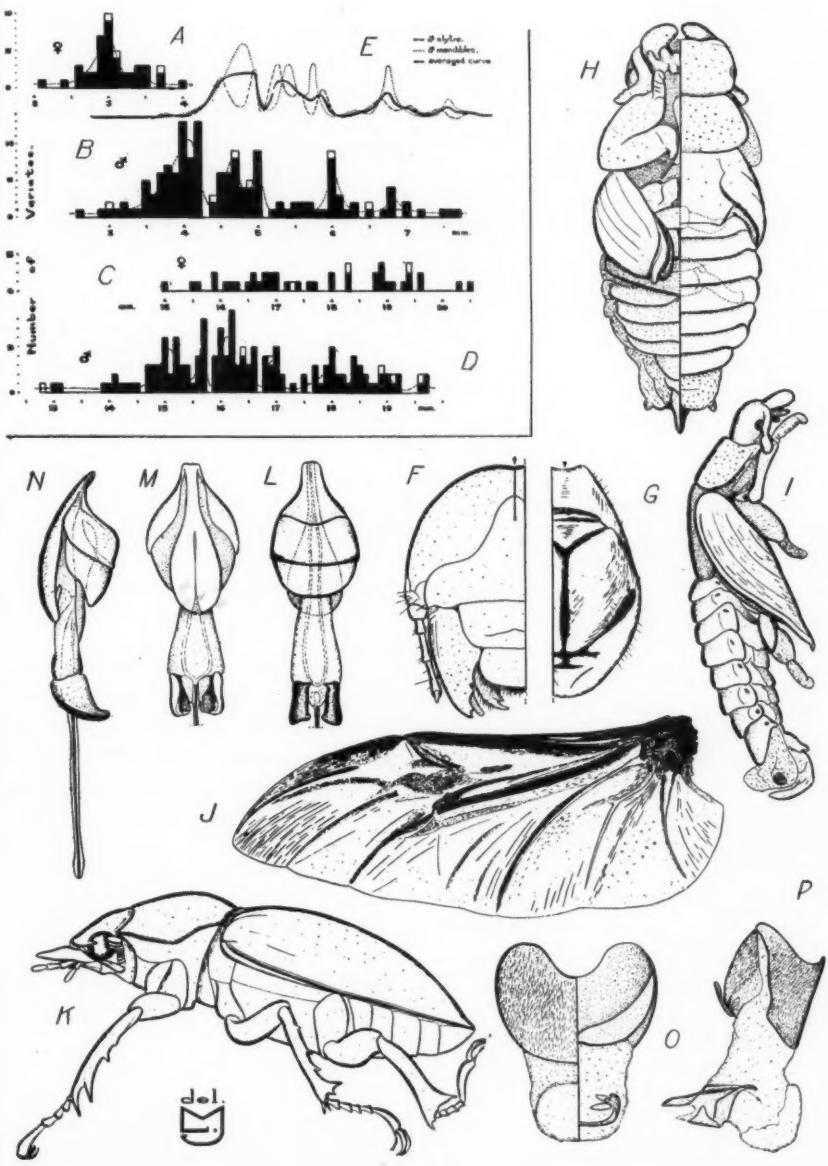
The place and hour of egg-laying are not known, but as larvae appear in the sod, it is probable that the eggs are dropped in the grass. Judging from the four groups of larval size, it is a fairly safe prediction that the life-cycle takes four years, with the sequence—

> adult—egg—summer I—winter I—1st instar—winter II—2nd instar—winter III—3rd instar—winter IV—4th instar—summer IV—pupa—imago—winter V—emerged adult—egg— . . . etc.

It is easy to understand the great damage occasioned by these larvae through the destruction of plant roots, for their diet closely parallels that of the very similar young *Phyllophaga.* Mr. Carl Selinger of New York State, finds the larva (?) in Oak, but all localities examined here, while Red (*Quercus rubra* L.) and White Oaks (*Q. alba* L.) are common enough, no rotten stumps pulled apart have yielded the characteristic "white grubs." On the other hand, scarcely an excavation of a foot's depth along the *live* root system of Oaks, Virginia Creeper, Boston Ivy, or various shrubs, but discloses a dozen of these larvae eating the more tender ends. Chrysanthemums, perennial poppies, phlox, etc., are attacked, and in severe infestations even the sod "can be rolled up like a

*I am, on the other hand, informed that at least in England, females of *L. cervus* are more abundant than males.

CAN. ENT. VOL. LXV. PLATE 6



MILNE.—PSEUDOLUCANUS PLACIDUS (SAY).

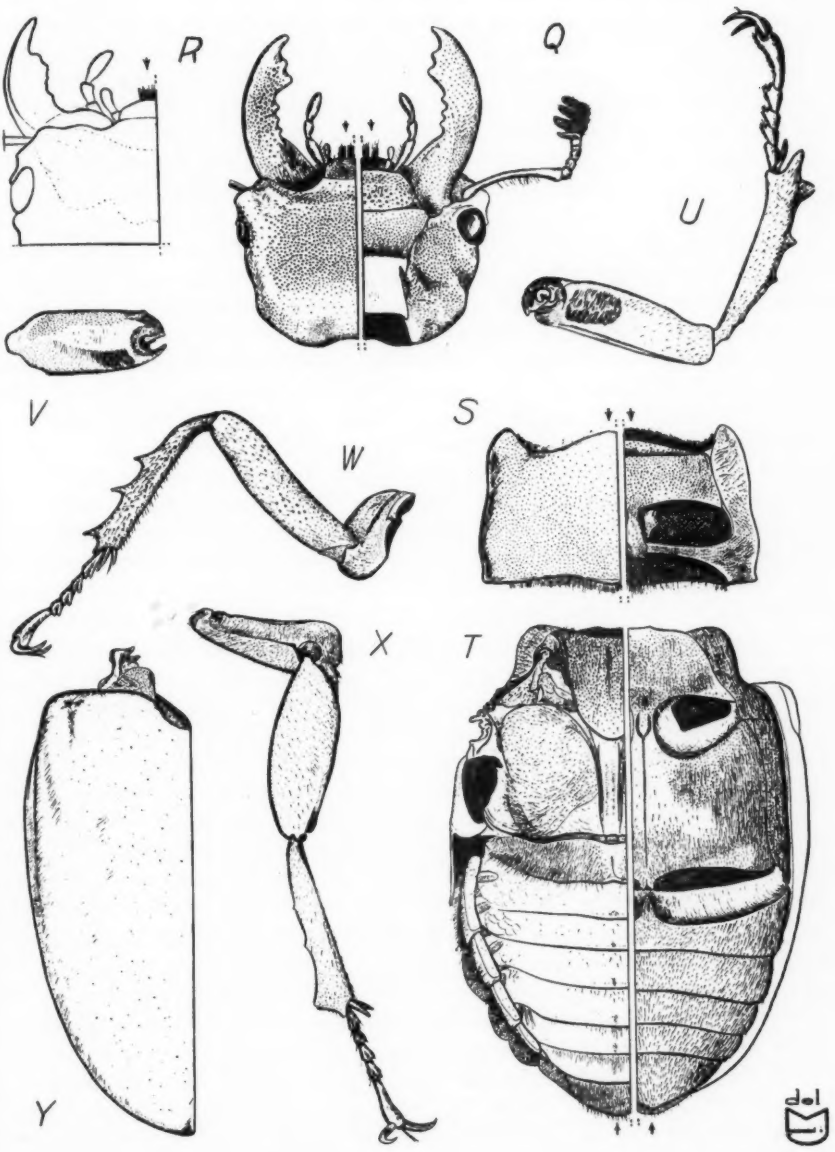
carpet," the roots being entirely gone and the grass dead. Ill-kept lawns are particular prey, and on sandy hillsides, the stubby tussocks of grass which spring up, are soon killed, leaving the slope as bare as before.

If two hundred adults emerge from a two-square yard area of ground, and the average dried adult weighs 0.4 grams, then the annual loss in dry beetle weight from this one pest alone amounts to over 400 lbs. per acre. And to produce one pound of beetle, much more than two pounds of roots must be sacrificed, since no animal yet known is even 50% efficient. This is dry weight of roots, not fresh weight, so that the damage is considerable. The instance quoted for the experimental plot is not more than an average infestation.

Granting a several-year life-history leads to a probable recurrence of cycles of relative abundance and scarcity. This is not very marked. The beetles have been quite common in season, since 1924, with the exception of 1926 and 1930. No records exist prior to 1924. Whether or not the weaker years bear out the suggested four-year cycle is questionable. A lack of usual numbers in 1934 might indicate something or the sort, but present extrapolation is not worthwhile. Strictness of tenure to a definite number of years of development is doubtful in all such cases of multiannual life-history, and until more data can be accumulated, inference seems the only treatment for facts.

Given that the length of development is *not* uniform for the species, or for one sex only, a variation in dimensions greater than that expected from the normal probability-curve would seem necessary. The one hundred and forty-five specimens taken on the night of the maximum emergence from the grass plot mentioned above, were measured with this in view, and histograms between length of parts in millimetres and numbers of specimens (variates) having those dimensions, are shown in Plate 6, figures A to D, for mandibles and elytra. Those specimens flying to the plot are indicated in unshaded rectangles where they fitted to the situation, but little weight was given to these observations. A frequency curve is superimposed in each case, polymodal to fit the measurements. A normal curve is not applicable as it is evident that many mandibular measurements lie outside the central range, and the males of 6.0 mm. and 6.8 mm., and females of 3.45 mm. and perhaps also of 4.0 mm. mandible-lengths, might be thought to belong to generations which early waxed fat and emerged. Another, and seemingly more plausible explanation is that the smaller specimens were starved larvae, which pupated and became imagines before reaching proper size, a year or more before the normal time. It is a rule applying to both plants and animals that partial starvation after a period of normal growth brings sexual maturity, and since the adult condition of an insect is no more than this, the present case may be a further example. The relative scarcity of females makes interpretation of the histograms concerning that sex much more doubtful than those of the males, even though the dispersion is less.

Elytral measurements spread over an even greater range, and are consequently of less use in indicating the hoped-for relationships. It would be unfair to neglect them, however, and figure E is an averaged curve drawn from the two sets of data (males only). The curves were fitted in what seemed an optimum position, the scales of abscissae having previously been prepared on lines of the same length. The measurements were made to the nearest tenth of a millimetre. Those for mandibles refer to the distance from the dorsal condyle to the apex,



MILNE.—PSEUDOLUCANUS PLACIDUS (SAY).

those for elytra the length along the suture. The selection of such definite parts was necessary since the total length of specimens is a very variable quantity, and dependent to too great an extent upon mounting, to be given any weight in such treatments as used above for the length-of-life-cycle problem. It should be noted, however, that while 90% of the males were an inch or less in length, none of the females were. And yet Leconte's comments (1869) upon the species indicate that the type (from Arkansas) was a female, and Say's original description (1825) states it to be of "length one inch" (25 mm.). Blatchley (1910) bears this out, with a 19 - 22 mm. range for the beetle. In this locality, the specimens vary between 19 mm. and 37 mm., with a mode for males at 32 mm., and for females at 29 mm.

Mr. J. W. Angell, of New York City, says *(i. litt.)* "two forms of the males occur, one entirely black, and the other with rufous elytra (may be immaturity)." From what has been said above, it will be plain that immature specimens are an impossibility, the pupa being early to late fall, and the imago having the whole winter and spring to harden. No teneral examples have been collected here. However, these males with piceo-rufous elytra comprise about one per cent of all specimens. The surface is rather more coarsely punctured, less shining, and nearly all seen are members of the upper quartile of the length range. Again no explanation is evident. It may be that Say's specimen was the rufous form, since he described it as "dark reddish-brown" but again the length as well as the sex makes this doubtful. No rufous females have come to hand in several thousand specimens examined. There appear to be no characters other than the colour and sculpture which can be used to separate these phases. The genitalia are like those of the black form.

The distribution of *P. placidus* when spread on a map of North America, appears fairly normal. It is recorded to be common in Illinois, Kentucky, Michigan and Pennsylvania, fairly common in Indiana, Missouri, Ohio and Wisconsin, elsewhere rare or absent. Records from Alabama, Arkansas (type locality), Iowa, Kansas, Minnesota, New Mexico, New York, New Jersey and Oklahoma, are at hand. At Buffalo, N. Y., it is reported as abundant. In Ontario, Point Pelee (Essex County) yields hordes, and a very restricted district in the western section of Toronto, originally a hilly, sandy, pine barren, of Transitional flora, is densely populated. Elsewhere in this and other provinces, the species is not only rare but apparently entirely absent. This intense localization is interesting.

In the accompanying two plates are given illustrations of many parts of the beetle, its pupa and larva. The last named, as mentioned above, very closely simulates the "white grub" of *Phyllophaga*, but differs in many details. The longitudinal anus is perhaps the most noticeable character, but there are a large number of others, mostly mentioned and shown in Boving and Craighead's 1931 paper "An Illustrated Synopsis of the Principal Larval Forms of the Order Coleoptera" in Entomologica Americana, Volume XI. It is apparently impossible to determine the sex of larvae of *P. placidus* and misfortune has settled on all attempts to get quantities of pupae, so that a few males constitute all studied, no females having successfully metamorphosed. No parasites emerged from the larvae under observation, but many died from a mildew or mold, due no doubt to the unnatural water relations in sandy soil under sod, contained in a metal can or glass jar.

The genitalia of the male pupa and the cercus-like hard projections from the toughly-membranous abdominal apex, are quite peculiar. The position of spiracles is clearly visible in the unsclerotized membrane connecting expanded sternite to smaller tergite in the abdominal region but details of the thoracic venter are not well marked. The mesothoracic legs might also be mentioned, since in most bettle pupae the wings are mesad of the appendages while here they envelope the knee joint and cover most of the femur and tibia. The tarsi and tibial apices project and cross one another, "tailor-fashion."

The genitalia of the three species of *Pseudolucanus* vary little either individually or specifically. In the male, the terminal ventral paired sclerites of the oedeagus show specific characters of feeble type, being more broad in *capreolus* and apically recurved in *mazama* (Lec.). In the female, the modified gonapophyses are almost indistinguishable in the three species, as also the post-anal inflation of the membrane. The resting position of the genitalia is a much-telescoped one. In the male, the long membranous penis is coiled around the oedeagus and the two together are withdrawn well within the protecting valves, the whole being deeply imbedded in the abdominal viscera by invagination of the usual supporting membranes. The gonapophyses of the female are flexed upwards at the tip, so that when the membranes are invaginated for protection, the postanal inflation presses down on them dorsally and also posteriorly, leaving the anus free to a sort of secondary cloaca.

The scaly nature of the abdominal tergites of the adult is very pronounced at the edges of segments II and III in particular. The alteration in direction of the long diameter of the spiracles to conform with the sunken nature of the tergites, will be seen to follow that laid out in the pupa. There seems to be complete uniformity of axes in the larval spiracles.

None of the literature examined has mentioned the sub-basal elliptical-to-circular patch of golden-yellow hairs, present on the dorsal surface of the fore femora of *P. placidus,* and also of *P. mazama,* but absent in *P. capreolus.* It would be interesting to know why this ornament was developed in a nocturnal insect. It is plainly visible when the beetle rears itself up in annoyance, but is naturally invisible after dark when the insect is above ground.

It should be noted that in all but the drawings of the male genitalia, only one half, or a shade more, of the specimen has been included. Where the figure is not divided on the mid line, a small arrow indicates that plane, and a pair of dashes at each end of the dividing line shows that it is not median. Except for the prothoracic leg, where the hairy patch was of interest, all figures of the adult are of the left side of the body. The larva and pupa, on the other hand, are illustrated for the right side only, principally because Boving and Craighead (referred to above) use and illustrate a key character of the left larval mandible and omit mention of the other side. The mandibles are as usual rather asymmetrical, but apparently constantly so.

Thanks are due to Mr. R. J. Sim of Riverton, N. J., for data donated in response to an "ad" running for over two years in the "Exchange" column of The Canadian Entomologist. His position is unique in being the sole entomologist not too busy to offer information on seeing this notice. Much appreciation is due Mr. J. W. Angell for his encouragement in the preparation of this paper, and

his assistance in passing on to the author such records as were in, or came to his collection.

KEY TO PLATES.

Plate 6.

Figure A—Histogram of mandible lengths of males
B—Histogram of mandible lengths of females.
C—Histogram of elytral lengths of males.
D—Histogram of elytral lengths of females.
E—Summation of frequency curves for males taken from figures A. and C.
F—Anterior view of larval head, X 4.3.
G—Posterior aspect of larval anal segment, X 4.3.
H—Ventero-dorsal view of male pupa, X 1.4.
I—Right lateral aspect of male pupa, X 1.4.
J—Left metathoracic wing of adult male, X 1.7.
K—Left lateral view of adult female, X 2.3.
L—Dorsal aspect of male genitalia, X 5.
M—Ventral aspect of male genitalia, X 5.
N—Right lateral aspect of male genitalia, X 5.
O—Dorso-ventral aspect of female genitalia, X 6.3.
P—Left lateral view of female genitalia, X 6.3.

Plate 7.

Figure Q—Dorso-ventral aspect of male head, X 4.
R—Dorsal aspect of female head, X 4.2.
S—Dorso-ventral aspect of male prothorax, X 4.
T—Dorso-ventral aspect of male meso- and metathorax and abdomen X 4.
U—Dorsal surface of male prothoracic leg, less coxa, X 4.
V—Ventral* view of male prothoracic coxa, X 4.
W—Ventral* view of male mesothoracic leg, X 4.
X—Ventral* view of male metathoracic leg, X 4.
Y—Dorsal view of male elytron, X 4.

*Not strictly ventral to the insect, but at right angles to the limb itself. This accounts for the apparent elongation of the coxae, which would be shortened in a ventral view taking the body for reference, because of the obliquity of the sides of the somewhat V-shaped sternum.

FOOD PLANTS AND DISTRIBUTION OF SOME UTAH THYSANOPTERA[1]

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Thrips have frequently been abundant in flowers and less abundant upon other parts of plants in most sections of Utah. Considerable thrips damage to onions occurs practically every year in most onion-growing areas of this state, while beans, beets, and other crop plants are less generally affected. It appears that damage, due to thrips, is more general in Utah than has usually been supposed. A desire to become better acquainted with the forms occurring upon various plant species in this region has led to this study. During the season of 1931, thrips were collected on a great variety of host plants and from as many localities as possible; during that season approximately 1500 slides were prepared. The writers are indebted to Dr. J. R. Watson, Entomologist of the Florida Experiment Station, for the identification of the forms herein recorded, and to M. J. Janes, T. O. Thatcher, and D. M. Hammond for assistance with the collecting.

Acolothrips fasciatus (Linn.). The striped or banded thrips has been col-

[1]Contribution from the Entomology Department, Utah Agricultural Experiment Station.

lected[3] upon alfalfa, aster, redscale, barley, bull thistle, burdock, carnation, *Chrysothamnus nauseosus, C. parryi,* corn, cowslip, curled dock, daisy, goldenglow, goldenrod, *Malva,* match brush *(Gutierrezia), Mentha,* oats, peas, primrose, rosin weed, *Sophia filipes,* tiesel, wild carrot, wild parsnip, and wheat. Localities from which collections were made include Blacksmith Fork Canyon, Cedar Fort, Emigration Canyon, Fielding, Far West, Hansel's Mountains, Junction, Logan, Mapleton, Park Valley, Raft River, Snowville, and Wellsville. One collection was made upon daisies at St. Charles, Idaho, August 30, 1931 (Janes and Thomas).

Chirothrips manicatus (Hali.). The manicate thrips was collected upon beans, dodder, elderberry, grass, morning glory, *Nepeta cataria,* potato, thistle, timothy, and wild carrot. Collections were made at Blacksmith Fork Canyon, College Ward, Garland, Logan, Logan Canyon, Mendon, Providence, River Heights, and Trenton. Specimens were taken in Idaho upon timothy at Lorenzo, July 20, 1931 (Thomas) and at St. Charles on July 28, 1931 (Knowlton).

Sericothrips variabilis (Beach). Collected at Bountiful, 1929 (H. J. Pack).

Scirtothrips gracillipes Wats. Upon boxelder, Roy, June 30, 1931 (Knowlton and Thomas).

Heliothrips phaseoli Hood. On *Mentha spicata,* Wellsville, September 2, 1931 (Knowlton).

Frankliniella minuta (Moulton). This species has been collected upon alfalfa, aster, *Artemisia tridentata,* beans, birch, black-eyed Susans, burdock, bull thistle, Canada thistle, *Chrysothamnus nauseosus, C. viscidiflorus, C. parryi, Cleome serrulata angusta,* cosmos, daisies, dandelion, geranium, goldenrod, goldenglow, *Gutierrezia, Mentha spicata, Mentzelia,* marigold, millet, morning glory, mustard, petunia, potato, rosin weed, *Sarcobatus vermiculatus,* shasta daisy, sunflower, *Teasel,* tiger lily, timothy, watercress, wild aster, wild morning glory, and yarrow. A partial list of the localities would include Blacksmith Fork Canyon, Callao, Cedar Fort, Curlew Valley, Daniel's Canyon, Deep Creek, Dry Lake, Etna, Fort Duchesne, Fruitland, Garden City, Grouse Creek, Gusher, Heber, Hailstone, Kimball, Lehi, Logan Canyon, Lynn, Mapleton, Myton, Nafton, Naples, Orr's Ranch, Paradise, Park Valley, Raft River Valley, Rosette, Roosevelt, Sardine Canyon, Uinta Mountains, Uintah, Wellsville Canyon, and Yost. This species was also collected in Idaho at Emigration Canyon, Lorenzo, Naf, Ovid, Paris, Montpelier, St. Charles, and Stanrod. Collections were made in Nevada in Antelope Valley and along the west margin of the Great Salt Lake Desert, August 5, 1931 (Knowlton and Hammond), and near Tacoma, on August 11, 1931 (Knowlton and Janes).

Frankliniella fusca (Hinds). This species was twice collected from peas in northern Utah at Fielding, June 25, 1931 (Knowlton and Thomas) and on morning glory at Logan, July 13, 1931 (Knowlton and Thomas). It was also taken upon dandelion at Lorenzo, Idaho, June 17, 1931 (Thomas).

Frankliniella moultoni Hood. This species has been collected, often in great abundance, from alfalfa, aster, wild aster, sugar-beet, bachelor's button, bluebell, bunchgrass, burdock, carnation, wild carrot, red, white, yellow, and sweet clovers, clematis, *Cleome serrulata angusta, Chrysothamnus parryi, C. viscidiflorus,* cowslip, cosmos, corn, Deseretweed, daisy, dahlia, dandelion, elderberry, English blossoms, foxtail, *Geranium,* goldenglow, goldenrod, *Gutierrezia,* gumplant,

[3]Unless otherwise indicated, collections were made in Utah.

ground-cherry, hollyhock, hops, Indian tobacco, linden, lupine, *Malva,* matrimony vine, *Mentzelia,* milkweed, marigold, mustard, *Nepeta cataria,* oyster plant, sweet and garden peas, wild parsnip, poppy and California poppy, *Plantago,* radish, rose and wild rose, sagebrush, skunk flowers, snapdragon, sneezeweed, squirreltail, sunflower, timothy, teasel, Canada thistle, tiger lily, and *Verbascum thapsus.* A partial list of Utah localities includes Avon, Beaver Dam, Bovine Point, Callao, Cedar Fort, Cedar Creek, Curlew, Daniels Canyon, Duchesne, Fairfield, Garden City, Granger, Grouse Creek, Heber, Hailstone, Hansel Valley, Ibapah, Kelton, Logan, Moffat, Myton, Muddy Creek, Naples, Nafton, Park Valley, Promontory, Raft River Valley, Silver City, Snowville, and Uintah. Collections were made in Idaho at Emigration Canyon, Fish Haven, Lorenzo, Montpelier, Ovid, Paris, St. Charles, and Strevell.

Frankliniella tritici (Fitch). The wheat or flower thrips was collected from arrow leaf, barley, bachelor's button, beets, beans, black-eyed Susan, burdock, buttercup, cactus, red, white, and sweet clover, *Cleome serrulata angusta,* chicory, *Chrysothamnus nauseosus,* clematis, cucumber, cosmos, daisy, dahlia, dandelion, dodder, Deseretweed, dogbane, elderberry, wild and cultivated morning glory, gaillardia, geranium, goldenrod, goldenglow, greasewood, gumplant, *Gutierrezia,* hound's tongue, linden, lupine, matrimony vine, milkweed, marigold, *Mentzelia, Mentha,* mullein, mustard, pansy, petunia, wild parsnip, poppy, potatoes, primrose, radish, *Rosa fendleri,* cultivated roses, sagebrush, shasta daisy, snapdragon, spearmint, squirrel tail, strawberry, sunflower, *Solanum triflorum, Salix, Salsola pestifer,* Canada thistle, bull whistle, teasel, *Tamarix* and zinnia. Utah localities from which collections were made include: Appledale, Amalga, Brigham Canyon, Bloomington, Corinne, Deep Creek, Emigration Canyon, Fort Duchesne, Fairfield, Gusher, Grouse Creek, Howell, Ibapah, Logan, Myton, Orr's Ranch, Payson, Park Valley, Riverside, Snowville, Soldier Creek, Vernal, and Yost.

Frankliniella occidentalis (Perg.). The western flower thrips has been taken upon *Artemisia tridentata, A. vulgaris,* alfalfa, cultivated and wild aster, beans, boxelder tree, bull thistle, burdock, carnation, cabbage, chicory, *Chrysothamnus nauseosus, C. parryi, C. viscidiflorus, Cleome serrulata angusta, C. lutea,* red, yellow, white, and sweet clover, columbine, corn, cucumber, daisy, dandelion, elderberry, tickle grass, geranium, goldenglow, greasewood, gumplant, *Gutierrezia,* hollyhock, *Lupinus, Malva,* matrimony vine, marigold, milkweed, *Mentzelia,* mustard, mullein, peas, petunia, *Plantago,* cultivated and wild poppy, primrose, radish, Russian thistle, snapdragon, *Solidago,* spearmint, strawberry, sunflower, skunkflower, squash, sweet William, teasel, tiger lily, tomato, *Verbascum thapsus, Verbena bracteosa,* watercress, wild parsnip, wild rose, yarrow, and zinnia. This species is generally distributed in northern Utah and was collected in Idaho at Emigration Canyon, Lorenzo, Malad, Montpelier, Ovid, Paris, Stanrod, Strevell, and in Nevada in Antelope Valley and on the east margin of the Great Salt Lake Desert.

Frankliniella helianthi (Moulton). The sunflower thrips was collected at Sunset, June 30, 1931, on tiger lily blossoms (Knowlton and Thomas) and at Clearfield, August 6, 1931, on sunflowers (Knowlton and Hammond).

Taeniothrips sp. Specimens belonging to this genus were collected upon wheat at Brigham City, and upon barley and sunflower at Providence during 1931.

Thrips tabaci Lind. The onion thrips has been found infesting *Amaranthus,* beans, beets, black-eyed Susan, bluebell, boxelder, bunch grass, buttercup, burdock, cat-tail, cabbage, red, white, yellow, and sweet clover, *Cleome serrulata angusta, Chrysothamnus nauseosus, C. parryi, C. viscidiflorus,* clematis, cosmos, chicory, wild carrot, cowslip, dandelion, daisy, curled dock, dodder, dogbane, elderberry, foxtail grass, *Geranium,* greasewood, groundcherry, grass, goldenrod, gumplant, *Gutierrezia,* hops, hound's tongue, Indian paint brush, and Indian tobacco. This species is generally distributed and causes considerable damage to onions in Utah and probably affects other crops. It has been collected in Idaho at Emigration Canyon, Fish Haven, Lorenzo, Montpelier, Ovid, Paris, and St. Charles, and from the Great Salt Lake Desert in Nevada, southwest of Wendover.

Thrips bremnerii Moulton. Bremner's thrips was collected from potato blossoms at Roy, June 30, 1931 (Knowlton and Thomas).

Thrips physapus Linn. Three collections of this species were made at Providence, July 15, 1931, one upon burdock (Knowlton and Hammond).

Thrips treherni Pr. This species was collected a number of times in northern Utah upon dandelion; in addition, it was collected upon bachelor's button, chicory, and sugar-beets. Collections were made at College Ward, Cornish, Corinne, Garden City, Grouse Creek, Logan, Logan Canyon, Providence, River Heights, and Saratoga, in Utah, and at Lorenzo and Montpelier, Idaho.

Anaphothrips obscurus (Mull.) was collected upon sagebrush, *Artemisia tridentata* in Logan Canyon, July 13, 1931 (Knowlton and Thatcher). It was also collected upon corn, oats, tomatoes, and wheat. Other localities were Fielding, Garland, Harrisville, Ogden, Roy, and Trenton.

Bregmatothrips sp. Collected upon lily in Logan Canyon, June 21, 1931 (Thomas).

Haplothrips leucanthemi (Schr.). Collected from daisy, lupine, peas, and red clover. Localities are Logan, Logan Canyon, Providence, and Sunset.

Haplothrips niger (Osb.). Although this species may be a synonym of *leucanthemi,* the more typical *niger* forms are here recorded. Collected on alfalfa, red, white, and sweet clovers, marsh rush, shasta daisy, and yarrow. Localities are Benson, Emigration Canyon, Garden City, Logan, Logan Canyon, Park Valley, Penrose, and River Heights. Also collected at Lorenzo, Idaho, July 20, 1931 (Thomas).

Neoheegeria verbasi (Osb.) The mullein thrips frequently becomes very abundant upon mullein, *Verbascum thapsus,* and has been collected upon this host from Blacksmith Fork Canyon, Brigham Canyon, Garden City, Hailstone, Lakota, Sniderville, and Wellsville.

Leptothrips mali Fitch. The black hunter has been collected upon apple, boxelder tree, *Artemisia tridentata,* Indian tobacco, *Malva,* and Russian thistle. Localities were Central, Crescent, Fairfield, Gold Hill, Logan, Logan Canyon, and Magna, in Utah and Lorenzo, Idaho, and Antelope Valley, Nevada.

A NEW SPECIES OF MONOCHAMUS FROM CALIFORNIA (COLEOPTERA, CERAMBYCIDAE)

BY E. GORTON LINSLEY,
Oakland, California.

Monochamus fulvomaculatus Linsley.

Robust, reddish-brown, sparsely clothed with fulvous and white pubescence. Head coarsely, rather densely punctured, sparsely clothed with recumbent white hairs; antennae slightly longer than the body (♀), segments bicolored, basal portion of each segment clothed with white pubescence, apex glabrous or finely clothed with brownish hairs; scape moderately stout, second segment about one-fifth as long as scape, third segment slightly less than half as long as scape, remaining segments diminishing gradually in length toward apex. Prothorax transverse, coarsely punctured, rugose, sparsely clothed with recumbent white hairs which at sides are mixed with fulvous; disc with a median glabrous area; lateral tubercles prominent, rather acute. Scutellum reddish-brown, shining. Elytra about twice as long as broad; pubescence variegated white and fulvous, the white predominating in sub-basal, median, and sub-apical regions, broken by numerous glabrous areas; puncturation coarse, rather dense in glabrous areas, obscured and arranged in a linear manner in pubescent areas; apices rotundate-truncate. Body beneath unicolorous, sparsely clothed with white hairs which are longer than those of the upper surface; abdomen finely and sparsely punctured. Length 22 mm., breadth 8 mm.

Type: Female (No. 3682, Calif. Acad. Sci.), captured on the eastern slopes of Mt Diablo, Calif., May 15, 1931, by Mr. A. T. McClay. One paratype taken with the type is in the collection of Mr. McClay, and one paratype taken on May 19, 1931, at the same locality is in the collection of the writer. The specimens were taken on Digger Pine, *Pinus sabiniana*.

This species is related to *M. maculosus* Hald. and *M. obtusus* Csy., but differs from these in form, sculpture, maculation, and the shape of the elytral apices. *M. fulvomaculatus* is shorter and more robust than either *maculosus* or *obtusus* and has a much whiter pubescence. The glabrous areas of the elytra are much more numerous and the elytral maculations are fulvous rather than dirty brown or black. In *M. maculosus* the elytral apices are prolonged at the sutural angle into an acute spine, in *M. fulvomaculatus* the apices are rotundate-truncate, and in *M. obtusus* the apices are evenly rounded. The author is indebted to Mr. Ralph Hopping for comparing *fulvomaculatus* with typical examples of various species in his collection.

Mr. Hopping's table of *Monochamus**, may be modified for the insertion of this species as follows.:

AA. Apices of elytra not produced into a spine or process.
  B. Elytral apex obtusely angulated at the suture.
    C. Elytra without raised linear elevations.
      D. Body black, unicolorous or variegated with white or gray pubescence.
        E. Scutellum generally covered with ashy scales, posterior margin rounded; elytra with a bronze lustre, maculation

*Hopping, R. Rev. of Genus *Monochamus*, Can. Ent. LIII, 1921, p. 255.

often entirely absent .....*scutellatus* Say.

EE. Scutellum biboled or V-shaped with only the lobes covered with ashy scales and separated by a minute triangular glabrous area; maculation of elytra absent or sparse .....*oregonensis* Lec.

DD. Body reddish-brown, variegated with white and fulvous pubescence. Scutellum glabrous, shining; elytra sparsely clothed with white and fulvous hairs, with numerous glabrous and more heavily punctured areas.....*fulvomaculatus* n. sp.

CC. Elytra with raised linear elevations.
Scutellum sparsely clothed except toward margins; elytra densely finely punctured with scattered, raised, often linear, glabrous areas; general color greyish brown .....*notatus* Drury

BB. Elytral apex not angulated at the suture, evenly rounded; punctation sparse and fine; scutellum glabrous and rufous; general color rufous.....
..... *obtusus* Casey

FOOD OF THE ROBBER FLY, MALLOPHORA ORCINA (WIED) (DIPTERA)

BY P. W. FATTIG,
Emory University, Georgia.

For several years I have been interested in the prey of the Robber Fly, *Mallophora orcina* (Weid). I have taken two hundred and eighteen specimens of this robber fly with its prey. The prey belonged to twenty-three species of insects.

It will be noticed that not a single specimen was taken with the large yellow jacket (*Vespa carolina*), although this species is as common here as is the smaller yellow jacket (*Vespa germanica*). Ten specimens were taken with *Liacos nobilitata,* while not a single specimen was taken with *Liacos bicincta,* although it is as common here as is *nobilitata.*

Thirty-nine specimens were taken with *Bombus impatiens,* while only two were taken with *Bombus separatus,* while not a single specimen was taken with *Bombus pennsylvanicus,* although this species is very common here.

Nineteen specimens were taken with *Polistes annularis,* and twenty-three with *Polistes rubiginosus,* while only one specimen was taken with *Polistes fuscatus,* and not a single specimen was taken with either *Polistes pallipes, Polistes minor* or *Polistes fuscatus,* variety *bellicosa.* The last three species of *Polistes* are not nearly as common here as are the first three species.

Forty-six specimens were taken with the honey bee. Two specimens were taken with horse flies. One specimen was observed to catch a grasshopper, but it dropped it in a very short time. I do not know whether it did not suit its taste, or whether the grasshopper was too heavy for it to hold.

I wish to thank Mr. C. T. Greene of the U. S. National Museum for determining the Tabanidae and Miss Grace Sandhouse and Mr. R. A. Cushman, also of the National Museum for identifying several of the Hymenoptera.

The list of species, together with the number of specimens were as follows:—

	Specimens
Elis carolina (Panzer)	3
Elis obscura (Fabr.)	8
Elis sp.	10
Liacos nobilitata (Fabr.)	10
Polistes annularis (Linn.)	19
Polistes rubiginosus (Lep.)	23
Polistes fuscatus	1
Apis mellifica (Linn.)	46
Bombus impatiens (Cress.)	39
Bombus separatus (Cress)	2
Vespa germanica (Fabr.)	42
Mellissodes compta (Cress.)	2
Melissodes caliginosa (Cress.)	1
Anthophora ursina (Cress)	2
Triepeolus concavus (Cress.)	1
Osmia chalybea (Smith)	1
Monobia quadridens (Linn.)	1
Tachytes elongatus (Cress.)	1
Psithyrus variabilis (Cress.)	2
Pepsis elegans (Lep.)	1
Trogus obsidianator (Brulle)	1
Tabanus trimaculatus (Beauv.)	1
Tabanus fulvulus (Wied.)	1

Mailed Monday, June 5th, 1933.